THE EFFECTS OF MUSCLE STRENGHT AND PHYSICAL FUNCTION ON BALANCE IN PERITONEAL DIALYSIS PATIENTS

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Introduction

Falls and associated fragility fractures are a major cause of morbidity and mortality in patients with kidney disease. Overall studies suggest that the fall rate is much greater in dialysis patients than in the general population (1). There are multiple causes of falls in PD patients. Deficits in balance control and muscle strength are two important intrinsic risk factors for falls. Balance can be classified as either static (attempting to maintain a base of support with minimal movement) or dynamic (attempting to maintain a stable base of support while completing a prescribed movement). Control of balance is essential in all postures and situations, both static and dynamic.

The aims of this study were i) to examine the physical function, muscle strength and balance of patients on peritoneal dialysis (PD) ii) to explore the effects of muscle strength and physical function on balance in PD patients.

Materials and Methods

Fifty-four dialysis patients (24 male, 30 female) and, thirty-four (14 male, 20 female) healthy controls were included into the study. Ethical approval was obtained and all participants gave informed consent before enrollment. Exclusion critera were the presence of neurologic or psychiatric diseases, arthritis, cardiovascular disease, severe visual or auditory impairments and the presence of cognitive deficits assessed by the Mini-Mental State. Examination (Mini Mental State Examination Score <24). Patients with orthopedic problems in the lower extremities due to other reasons were also excluded. Functional capacity was evaluated according to the Karnofsky index of performance status (2). We included subjects with scale 1 or 2 according to the Karnofsky index of performance status.

Physical Performance Tests:

The Timed up and go (TUG) test, measures balance/physical mobility in a practical setting (2). **Gait velocity test** is a measure of gait velocity and function (3). **The timed chair stand test**, is a physical performance test used to assess lower-extremity function. (3). **Stair climb test**, is a physical performance test (4). **Hand grip test** is to measure the maximum isometric strength of the hand and forearm muscles (5). **Isokinetic (dynamic) peak torque** (PT) of the dominant knee extensor and flexor muscles (isokinetic muscle strength) were measured in a sitting position with a Biodex System 3 Pro (Biodex, Inc., Shirley, NY, USA) (4,5).

Static Balance Test: The Functional Reach Test is used as a test of static balance (6).

Dynamic Balance Test: TUG test measures dynamic balance/physical mobility in a practical setting (3).

Statistical Analysis:

Statistical Package for Social Science (SPSS, Chicago, IL, USA) software version 16.0 was used for statistical evaluation. The independent sample t-test was used for the normally distributed parameters and Mann-Whitney U test test was used for the non-normal distributed parameters to compare the groups. Spearman's and Pearson correlation analysis were used to assess the relationship between variables. In addition, we assessed independent variables associated with Functional reach test(Static balance) and TUG Test (Dynamic Balance) using stepwise multiple regression analysis. All p values of less than 0.05 were considered to indicate significance.

Results

The patients had been receiving PD for 40.25±3.53 months. Comparison of scores of objective physical performance tests, muscle strength tests and balance tests between the patients and controls are shown in Table 1. In multiple regression analyses, the independent predictors of TUG Test (Dynamic Balance) were age, extension peak torque at 60°/*sec N.m* in PD patients, whereas serum albumin and duration of dialysis had no independent effect on TUG Test (Dynamic Balance) (Table 3). The independent predictors of functional reach test (Static balance) were age, extension peak torque at 60°/*sec N.m* in PD patients, whereas serum albumin and duration of dialysis had no independent effect on static balance (Table 2).

Discussion

We used objective measures of physical performance tests (TUG test, timed chair stand test, gait velocity test, and stair climb test) to evaluate physical performance in our patients and controls. Since the TUG test provides information about transfer, balance and gait speed, this finding confirms the fact that dialysis patients have more difficulty in accomplishing functional tasks releated to mobility and transfering or more careful when performing them. The dialysis patients studied here were significantly slower than healthy controls at usual pace. Bohannon et al. showed that among kidney transplant candidates the walking speed and knee extension force are decreased compared with healthy subjects. These results agree with those of the present study (7). The timed chair stand test and stair climb test are physical performance tests used to assess lower-extremity function. Also, these are important functional activities of daily life. The PD patients took significantly longer to complete the timed chair stand test and stair climb test then did controls in our study. Our study demonstrated that the knee flexor and extansor muscles of the dialysis patients were weaker than those of healthy control subjects. The relationship between muscle strength and physical performance tests has been reported. Carter et al. determined the associations among knee extension strength, medication history, medical history, physical activity and both static and dynamic balance in women diagnosed with osteoporosis. These authors found that knee extension strength is a significant determinant of performance on static and dynamic balance tests in older women with osteoporosis (8). Investigators have reported significant correlations between postural stability, quadriceps, ankle dorsiflexion and hand-grip strength, tibialis anterior latency and functional clinical balance testing among older adults (9). In our study, static and dynamic balance were significantly impaired in dialysis patients than controls.

In conclusion, our results reveal the patients on PD had a lower physical functioning, poor balance and muscle strength compared to healthy controls. We found a significant correlation between lower extremity muscle strength and balance in peritoneal dialysis patients. These results may be important in terms of managing patients with CRF and on dialysis since encouraging physical exercise, strength and balance training may improve the physical functioning and prevent the falls associated with fragility fractures.

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Table 1. Scores of objective physical performance tests, muscle strength tests and balance tests

	Periton Dialysis Group (n=54, mean±SD)	Control Group (n=34, mean±SD)	p
Physical performance Tests			
TUG Test (s)	9.07 ± 2.78	6.91 ± 1.04	0.001
Gait Velocity Test (s)	28.18 ± 3.34	25.21 ± 2.04	0.001
Timed Chair Stand Test (s)	11.35 ± 3.32	8.94 ± 1.78	0.001
Stair Climb Test (s)	11.33 ± 5.64	7.69 ± 1.11	0.001
Isometric Strength (Hand Grip Test)	22.35 ± 8.39	27.26 ±11.24	0.039
Isokinetic Strength			
PT 60 ext	76.88 ± 30.58	96.42 ± 37.49	0.017
PT 60 flex	34.22 ± 18.22	47.80 ± 23.90	0.007
PT 90 ext	70.76 ± 27.13	89.54 ± 34.87	0.013
PT 90 flex	32.77 ± 17.05	46.26 ± 23.19	0.003
PT 120 ext	59.46 ± 22.10	75.33 ± 28.50	0.010
PT 120 flex	26.84 ± 13.54	38.32 ± 18.30	0.004
PT 180 ext	45.54 ± 16.78	57.39 ± 21.83	0.011
PT 180 flex	24.86 ± 11.00	32.25 ± 15.10	0.026
Balance Tests			
Static Balance (Functional Reach Test)	20.53±5.85	24.02±6.98	0.013
Dynamic Balance (TUG Test)	9.07 ± 2.78	6.91 ± 1.04	0.001

Table 2. Independent predictors of TUG Test (Dynamic Balance) and Functional reach test (Static balance) in Multiple regression analysis

Variables			R^2:0,260
Dependent	Independent	β	p
TUG Test (Dynamic Balance)	Age	0,260	0,038
	PT60 ext	-0,437	0,001
	Serum albumin		NS
	Duration of dialysis		NS
Variables			R^2:0,503
Dependent	Independent	β	p
Functional reach test (Static balance)	Age	-0,467	0,000
	PT60 ext	0,525	0,000
	Serum albumin		NS
	Duration of dialysis		NS

DOI: 10.3252/pso.eu.54ERA.2017